CLAIMS

What is claimed is:

1. A method of reducing dispatching delays in a push-to-talk radio network, the method comprising:

assigning a pool of downlink channels to be shared by a group of radio nets;

monitoring one or more uplink channels associated with mobile terminals in the group of radio nets for dispatch traffic such that the mobile terminals can transmit dispatch traffic to the network on the one or more uplink channels without need for explicit channel grant/request procedures;

receiving dispatch traffic from an originating one of the mobile terminals; and

retransmitting the dispatch traffic on one of the downlink channels that currently is selected as a downlink control channel for the group, along with transmitting an indication of radio net identity of the originating mobile terminal to enable other mobile terminals in the radio net of the originating mobile terminal to recognize the dispatch traffic as being targeted to them.

2. The method of claim 1, further comprising transmitting an indication of control channel reassignment on the selected downlink control channel along with retransmitting the dispatch traffic to enable mobile terminals not in the radio net of the originating mobile terminal to move to a newly selected downlink control channel as indicated by the indication of control channel reassignment.

3. The method of claim 2, further comprising selecting the newly selected downlink control channel from the pool of downlink channels.

4. The method of claim 2, further comprising periodically repeating transmission of the indication of control channel reassignment on the selected downlink control channel.

5. The method of claim 4, further comprising updating the indication of control channel reassignment being transmitted on the selected downlink control channel to reflect any subsequent control channel reassignments.

6. The method of claim 1, further comprising transmitting an indication of mobile terminal identity of the originating mobile terminal on the selected downlink control channel along with retransmitting the dispatch traffic.

7. The method of claim 1, further comprising transmitting an end-of-message indicator on the downlink control channel to indicate an end of dispatch traffic from the originating mobile terminal.

8. The method of claim 1, wherein the uplink and downlink channels comprise at least one of selected channel frequencies, selected time slot assignments within TDMA frames, and selected spread spectrum spreading code assignments.

9. The method of claim 8, wherein the selected spread spectrum spreading codes comprise one or more frequency-hopping sequences.

10. The method of claim 8, wherein the spread spectrum spreading codes comprise a direct sequence spreading code.

11. The method of claim 1, wherein receiving dispatch traffic from an originating one of the mobile terminals comprises receiving the dispatch traffic at a network ground station via relay through an associated satellite relay station.

12. The method of claim 1, wherein retransmitting the dispatch traffic on one of the downlink channels that currently is selected as a downlink control channel for the group, along with transmitting an indication of radio net identity of the originating mobile terminal to enable other mobile terminals in the radio net of the originating mobile terminal to recognize the dispatch traffic as being targeted to them comprises transmitting from a network ground station to an associated satellite relay station for retransmission to the mobile terminals.

13. A method of reducing dispatching delays in a push-to-talk radio network, the method comprising:

allocating a pool of channels to be shared by a plurality of radio nets;

using one or more downlink channels in the pool as downlink control channels;

associating one or more uplink channels with each downlink control channel and assigning one or more radio nets to each downlink control channel;

monitoring the one or more uplink channels for dispatch traffic from mobile terminals assigned to the one or more uplink channels to thereby enable transmissions of dispatch traffic from the mobile terminals to the network without need for explicit channel/grant request procedures;

receiving dispatch traffic from an originating mobile terminal in one of the radio nets assigned to the one or more uplink channels; and

transmitting downlink traffic channel assignments on the associated downlink control channel for receipt by mobile terminals in the radio net of the originating mobile terminal and, substantially, at the same time, retransmitting the dispatch traffic from the originating mobile terminal on one or more downlink traffic channels corresponding to the downlink traffic channel assignments.

14. The method of claim 13, wherein each downlink control channel comprises a time-multiplexed channel having one or more timeslots, with each timeslot being allocated to one of

the radio nets assigned to the downlink control channel, and wherein transmitting downlink traffic channel assignments on the associated downlink control channel for receipt by mobile terminals in the radio net of the originating mobile terminal comprises transmitting downlink traffic channel information in the timeslot allocated to the radio net of the originating mobile terminal.

15. The method of claim 14, further comprising associating a set of available downlink channel resources with the multiplexed downlink control channel, and wherein transmitting downlink traffic channel information the timeslot allocated to the radio net of the originating mobile terminal comprises transmitting a downlink traffic channel assignment corresponding to a downlink traffic channel selected from the available downlink channel resources.

16. A method of reducing dispatching delays in a push-to-talk radio network, the method comprising:

assigning mobile terminals belonging to one or more radio nets to a shared uplink channel;

detecting transmission of dispatch traffic on the shared uplink channel from an originating mobile terminal in one of the radio nets; and

retransmitting the dispatch traffic on a downlink channel assigned to the radio net of the originating mobile terminal.

17. The method of claim 16, wherein the downlink channel assigned to the radio net of the originating mobile station is a shared downlink channel shared by mobile terminals in the one or more radio nets, and wherein retransmitting the dispatch traffic on a downlink channel assigned to the radio net of the originating mobile terminal comprises retransmitting the dispatch traffic on the shared downlink control channel.

18. The method of claim 17, further comprising transmitting an indicator of radio net identity on the shared downlink channel along with retransmitting the dispatch traffic to enable mobile terminals sharing the shared downlink channel to determine whether they should process the retransmitted dispatch traffic based on belonging to the radio net of the originating mobile terminal.

19. The method of claim 17, further comprising transmitting an indicator of mobile terminal identity on the shared downlink channel along with retransmitting the dispatch traffic to enable the originating mobile terminal to determine that it has seized the shared uplink channel.

20. The method of claim 17, further comprising transmitting an indicator of a new shared downlink channel assignment on the shared downlink channel along with retransmitting the dispatch traffic to enable mobile terminals sharing the shared downlink channel that are not in the radio net of the originating mobile terminal to begin monitoring a new shared downlink channel.

21. The method of claim 17, further comprising repeating the transmission of the indicator of the new shared downlink channel assignment periodically.

22. The method of claim 17, further comprising transmitting an indicator of subsequent new shared downlink channel assignments as needed on the shared downlink channel.

23. The method of claim17, further comprising transmitting an indication of a new shared uplink channel on the shared downlink channel.

24. The method of claim 17, further comprising transmitting an indicator of a new shared uplink channel and a new shared downlink channel on the shared downlink channel.

25. The method of claim 17, further comprising transmitting an end-of-message indicator on the shared downlink channel to indicate an end of dispatch traffic from the originating mobile terminal.

26. The method of claim 25, further comprising repeating the transmission of the end-of-message indicator on the shared downlink channel one or more times.

27. The method of claim 26, wherein repeating the transmission of the end-of-message indicator on the shared downlink channel one or more times comprises repeating transmission of the end-of-message indicator until detected by the originating mobile terminal.

28. The method of claim 16, wherein a multiplexed downlink channel is assigned to the one or more radio nets, and wherein retransmitting the dispatch traffic on a downlink channel assigned to the radio net of the originating mobile terminal comprises:

transmitting a downlink traffic channel assignment on the multiplexed downlink channel for the radio net of the originating mobile terminal; and

substantially at the same time, retransmitting the dispatch traffic on an assigned downlink traffic channel corresponding to the downlink traffic channel assignment.

29. The method of claim 28, wherein transmitting a downlink traffic channel assignment on the multiplexed downlink channel for the radio net of the originating mobile terminal comprises transmitting the downlink traffic channel assignment in one or more timeslots of the multiplexed downlink channel that are allocated to the radio net of the originating mobile terminal.

30. The method of claim 28, wherein retransmitting the dispatch traffic on the assigned downlink traffic channel comprises transmitting an initial portion of a defined speech frame

coincident with one of the timeslots allocated to the radio net of the originating mobile terminal, suspending transmissions for a defined interval corresponding to a mobile terminal wake-up time, and then resuming transmission of a remaining portion of the speech frame.

31. The method of claim 16, further comprising managing a plurality of radio nets by assigning groups of radio nets to shared uplink and downlink channels selected from one or more pools of channel resources at the network, and further comprising reassigning radio nets from one group to another as needed to maintain an average duty factor of each group within a desired range.

32. The method of claim 31, further comprising removing particularly high duty factor radio nets from their respective groups and individually assigning them to uplink and downlink channels not shared by other radio nets.

33. A communications system using orthogonal spread spectrum coding and providing reduced dispatching delays, the system comprising:

an overhead control channel transmitted using a first orthogonal code, the overhead control channel being divided into timeslots, each timeslot being assigned to a given group of mobile terminals that form a radio net;

a random access receiver to detect transmissions initiated by any originating one of the mobile terminals; and

encoding and decoding circuits to decode the detected transmissions and re-encode them on a currently unassigned second orthogonal code, and to encode an indication of the second orthogonal code for transmission in the overhead control channel timeslot assigned to the radio net of the originating mobile terminal.

34. The system of claim 33, wherein an identification of the originating mobile terminal also is encoded by said encoder into the overhead control channel timeslot assigned to the radio net to which the originating mobile terminal belongs.

35. The system of claim 33, wherein the decoding circuit is configured to detect a specific End-of-Message (EOM) code and re-encode the EOM for retransmission in the overhead control channel timeslot one or more times before reverting the overhead control channel transmission to an idle pattern.

36. The system of claim 35, wherein the originating mobile terminal continues to transmit the EOM code until the re-encoded EOM is detected by the originating mobile terminal, whereupon the originating mobile terminal ceases transmission.

37. The system of claim 35, wherein the re-encoded EOM is transmitted until the system detects that the originating mobile terminal has ceased transmission.

38. A communication network that provides reduced dispatching delays in push-to-talk radio communications, wherein mobile terminals in one or more radio nets are assigned to one or more uplink channels, the network comprising:

a network receiver configured to detect random access transmissions of dispatch traffic on the one or more uplink channels from an originating mobile terminal in one of the radio nets; and

a network transmitter to retransmit the dispatch traffic on a downlink channel assigned to the radio net of the originating mobile terminal.

39. The network of claim 38, wherein a shared downlink channel is associated with the one or more uplink channels and is shared by the one or more radio nets, and wherein the network transmitter is configured to retransmit the dispatch traffic on the shared downlink channel.

40. The network of claim 39, wherein the network transmitter is configured to transmit an indicator of radio net identity on the shared downlink channel along with retransmitting the dispatch traffic so that mobile terminals sharing the shared downlink channel can determine whether they are in the radio net of originating mobile terminal and therefore should process the dispatch traffic being retransmitted by the network.

41. The network of claim 39, wherein the one or more uplink channels comprise a shared uplink channel shared by the one or more radio nets, and wherein the network transmitter is configured to transmit an indicator of mobile terminal identity on the shared downlink channel along with retransmitting the dispatch traffic so that the originating mobile terminal can determine that it has seized the shared uplink channel.

42. The network of claim 39, wherein the network transmitter is configured to transmit an indicator of a new shared downlink channel assignment on the shared downlink channel along with retransmitting the dispatch traffic so that mobile terminals sharing the shared downlink channel that are not in the radio net of the originating mobile terminal can begin monitoring a new shared downlink channel.

43. The network of claim 42, wherein the network transmitter is configured to repeat the transmission of the indicator of the new shared downlink channel assignment one or more times.

44. The network of claim 42, wherein the network transmitter is configured to transmit indicators of subsequent new shared downlink channel assignments as needed on the shared downlink channel.

45. The network of claim 39, wherein the network transmitter is configured to transmit an end-of-message indicator on the shared downlink channel to indicate an end of dispatch traffic from the originating mobile terminal.

46. The network of claim 45, wherein the network transmitter is configured to repeat transmission of the end-of-message indicator on the shared downlink channel one or more times.

47. The network of claim 38, wherein the network transmitter is configured to provide a multiplexed downlink channel to which the one or more radio nets are assigned, and wherein the network transmitter is configured to retransmit the dispatch traffic on a downlink traffic channel assigned to the radio net of the originating mobile terminal by:

transmitting a downlink traffic channel assignment on the multiplexed downlink channel for the radio net of the originating mobile terminal; and

substantially at the same time, retransmitting the dispatch traffic on an assigned downlink traffic channel corresponding to the downlink traffic channel assignment transmitted on the multiplexed downlink channel.

48. The network of claim 47, wherein the network transmitter is configured to transmit the downlink traffic channel assignment on the multiplexed downlink channel for the radio net of the originating mobile terminal by transmitting the downlink traffic channel assignment in one or more timeslots of the multiplexed downlink channel that are allocated to the radio net of the originating mobile terminal.

49. The network of claim 48, wherein the network transmitter is configured to retransmit the dispatch traffic on the assigned downlink traffic channel by transmitting an initial portion of a defined speech frame coincident with one of the timeslots allocated to the radio net of the originating mobile terminal, suspending transmissions for defined interval corresponding to a mobile terminal wake-up time, and then resuming transmission of a remaining portion of the speech frame.

50. The network of claim 38, further comprising a resource management processor configured to manage a plurality of radio nets by assigning groups of radio nets to shared uplink and downlink channels selected from one or more pools of channel resources at the network, and further by reassigning radio nets from one group to another as needed to maintain an average duty factor of each group within a desired range.

51. The network of claim 50, wherein the resource management processor is configured to remove particularly high duty factor radio nets from their respective groups and individually assigning them to uplink and downlink channels not shared by other radio nets.

52. A method of providing push-to-talk communications with reduced dispatching delays at a first mobile terminal, the method comprising:

monitoring a downlink control channel shared by mobile terminals in one or more radio nets to detect whether the network is retransmitting dispatch traffic targeted to the radio net of the first mobile terminal; and

receiving and processing the retransmitted dispatch traffic if it is targeted to the radio net of the first mobile terminal.

53. The method of claim 52, further comprising monitoring the downlink control channel for an indication of a new downlink control channel assignment and switching to monitoring the new downlink control channel if the retransmitted dispatch traffic is not targeted to the radio net of the first mobile terminal.

54. The method of claim 52, wherein monitoring a downlink control channel shared by mobile terminals in one or more radio nets to detect whether the network is retransmitting dispatch traffic targeted to the radio net of the first mobile terminal comprises receiving retransmitted dispatch traffic on the downlink control channel and recovering an indication of radio net identity from the retransmitted dispatch traffic.

55. The method of claim 54, further comprising, after an end of the retransmitted dispatch traffic, receiving an indication of a new downlink control channel assignment on the downlink control channel, and switching to monitoring the new downlink control channel.

56. The method of claim 54, wherein receiving and processing the retransmitted dispatch traffic if it is targeted to the radio net of the first mobile terminal comprises recovering transmitted data from received retransmitted dispatch traffic if the recovered radio net identity matches the radio net identity of the first mobile terminal.

57. The method of claim 52, wherein monitoring a downlink control channel shared by mobile terminals in one or more radio nets to detect whether the network is retransmitting dispatch traffic targeted to the radio net of the first mobile terminal comprises monitoring an allocated sub-channel of a multiplexed downlink control channel for an indication that the network is or will be retransmitting dispatch traffic targeted to the radio net of the first mobile terminal.

58. The method of claim 57, wherein the indication that the network is or will be retransmitting dispatch traffic targeted to the radio net of the first mobile terminal identifies a downlink traffic channel, and wherein receiving and processing the retransmitted dispatch traffic if it is targeted to the radio net of the first mobile terminal comprises receiving the retransmitted dispatch traffic on the identified downlink traffic channel.

59. The method of claim 52, further comprising receiving an indication of mobile terminal identity for an originating mobile terminal that originated the retransmitted dispatch traffic.

60. The method of claim 59, further comprising, if the retransmitted dispatch traffic is targeted to the radio net of the first mobile terminal, using the received mobile terminal identity in secure decoding of the retransmitted dispatch traffic.

61. The method of claim 52, further comprising transmitting dispatch traffic from the first mobile terminal on an uplink control channel to which the first mobile terminal is assigned responsive to push-to-talk events at the first mobile terminal, wherein the uplink control channel is shared by mobile terminals in the one or more radio nets.

62. The method of claim 61, further comprising monitoring the downlink control channel for an indication that the first mobile has seized the uplink control channel.

63. A mobile terminal for use in a push-to-talk communication network with reduced dispatching delays, the mobile terminal comprising:

a receiver circuit to receive retransmitted dispatch traffic on a downlink control channel shared by mobile terminals in one or more radio nets; and

a processor circuit to monitor the downlink control channel to detect whether the network is retransmitting dispatch traffic targeted to the radio net of the mobile terminal,

and to process the retransmitted dispatch traffic if it is targeted to the radio net of the mobile terminal.

64. The mobile terminal of claim 63, wherein the processor circuit is configured to monitor the downlink control channel for an indication of a new downlink control channel assignment and to switch the receiver circuit to begin monitoring the new downlink control channel if the retransmitted dispatch traffic is not targeted to the radio net of the mobile terminal.

65. The mobile terminal of claim 63, wherein the processor circuit is configured to monitor the downlink control channel to detect whether the network is retransmitting dispatch traffic targeted to the radio net of the mobile terminal by receiving retransmitted dispatch traffic on the downlink control channel and recovering an indication of radio net identity from the retransmitted dispatch traffic.

66. The mobile terminal of claim 65, wherein, if the retransmitted dispatch traffic was targeted to the radio net of the mobile terminal, the processor circuit is configured to switch the receiver circuit to begin monitoring a new downlink control channel responsive to detecting an indication of a new downlink control channel assignment transmitted on the downlink control channel after an end of the retransmitted dispatch traffic.

67. The mobile terminal of claim 63, wherein the processor circuit is configured to process the retransmitted dispatch traffic if it is targeted to the radio net of the mobile terminal by recovering a radio net identity from the retransmitted dispatch traffic and selectively recovering transmitted data from the retransmitted dispatch traffic if the radio net identity matches that of the mobile terminal.

68. The mobile terminal of claim 63, wherein the downlink control channel shared by mobile terminals in one or more radio nets comprises a multiplexed downlink control channel, and wherein the processor circuit is configured to detect whether the network is retransmitting dispatch traffic targeted to the radio net of the mobile terminal by monitoring an allocated sub-channel of the multiplexed downlink control channel for an indication that the network is or will be retransmitting dispatch traffic targeted to the radio net of the mobile terminal.

69. The mobile terminal of claim 68, wherein the indication that the network is or will be retransmitting dispatch traffic targeted to the radio net of the mobile terminal identifies a downlink traffic channel, and wherein the processor circuit is configured to configure the receiver circuit to receive the retransmitted dispatch traffic on the identified downlink traffic channel.

70. The mobile terminal of claim 63, wherein the mobile terminal receives an indication of mobile terminal identity for an originating mobile terminal that originated the retransmitted dispatch traffic.

71. The mobile terminal of claim 70, wherein the processor circuit is configured to use the mobile terminal identity in secure decoding of the retransmitted dispatch traffic if the retransmitted dispatch traffic is targeted to the radio net of the mobile terminal.

72. The mobile terminal of claim 63, wherein the processor circuit is configured to transmit dispatch traffic via the receiver circuit on an uplink control channel to which the mobile terminal is assigned responsive to push-to-talk events at the mobile terminal.

73. The mobile terminal of claim 72, wherein the processor circuit is configured to monitor the downlink control channel for an indication that the mobile terminal has seized the uplink control channel.

74. A method for reducing latency in a trunked dispatch communication system comprising:

allocating a plurality of radio nets to an uplink and downlink control channel; and

allowing a given one of the radio nets to retain the uplink and downlink control channel for traffic transmission responsive to the given radio net becoming active while reallocating remaining ones of the radio nets to a new uplink and downlink control channel, thereby associating any reallocation delays to inactive radio nets rather than to active radio nets.

75. A method of operating a relay station to provide push-to-talk communications for a plurality of radio nets, each radio net comprising a plurality of transmitter-receiver terminals, the method comprising:

allocating an initial uplink and downlink channel to be shared by a group of the radio nets;

detecting a transmission of traffic from one of the terminals and determining an identity of the terminal;

decoding, re-encoding, and transmitting the traffic on the downlink channel; and

transmitting an indication of the identity of the terminal and the radio net to which the terminal belongs and transmitting the indication on periodically on the downlink channel along with an indication of a new shared uplink and downlink channel to which other radio nets in the group should move.

76. A transmitter-receiver terminal for use in a trunked dispatch communication system comprising:

a receiver to decode a relay station signal and to determine whether, in a first case, the relay station signal is indicative of an idle control channel, or, in a second case, is indicative of an active traffic channel carrying traffic intended for the terminal, or,

in a third case, is indicative of an active traffic channel carrying traffic not intended for the terminal; and

a transmitter to transmit a terminal signal to a relay station using a first signal format in the first case, using a second signal format in the second case, and to terminate transmission in the third case.

77. The terminal of claim 76, wherein the receiver is configured further to determine whether, in a fourth case, the relay station signal is indicative of an active traffic channel carrying an end-of-message indication intended for the terminal.

78. The terminal of claim 77, wherein the transmitter is configured to transmit the terminal signal using a third signal format that indicates an end-of-message until the receiver of the terminal detects the fourth case.

79. The terminal of claim 76, wherein the terminal is configured to initiate a transmission of traffic to a relay station and, upon completing transmission of the traffic, is configured to transmit an end-of-message indicator to the relay station until the terminal detects a corresponding end-of-message indicator in the relay station signal being transmitted from the relay station.